What is claimed is:

1. A method for determining a position of a gamma ray interaction, the method comprising:

emitting light in a medium in response to an interaction between a gamma ray and the medium;

determining a first multi-dimensional position of the interaction using a plurality of photodetectors; and

producing a drift field in the medium to direct ionization electrons resulting from the interaction to determine a second multi-dimensional position of the interaction based on a position of the ionization electrons.

2. The method of claim 1, wherein the drift field directs ionization electrons resulting from the interaction to a collector and wherein the second multi-dimensional position of the interaction is determined by localizing the position of the interaction in two dimensions in the collector.

3. The method of claim 1, wherein a third multi-dimensional position is determined based on a time of arrival of the ionization electrons relative to when light has been emitted from the medium.

4. The method according to claim 1, wherein the medium is a liquid.

5. The method according to claim 4, wherein the medium is at least one of liquid xenon (Xe), liquid krypton (Kr) and liquid argon (Ar).

6. The method according to claim 1, wherein the medium is a noble gas.

7. The method according to claim 1, wherein the collector comprises a two-dimensional collection electrode array.

8. The method according to claim 1, wherein the drift field is established to provide a constant velocity in the medium.

9. The method according to claim 8, wherein the medium is liquid xenon and the drift field set to 1 kV/cm causing the ionization electrons to drift at a speed of 0.2 cm/μs.

10. The method according to claim 1, wherein the photodetectors include at least one of photo-multiplier tubes, position sensitive photo multipliers, photodiodes, avalanche photodiodes, hybrid photodiodes, visible light photodetectors, and any position sensitive photo-detectors.

11. The method of claim 3, further comprising:

opening a portion of an electronic shutter system that corresponds to an approximate position of the interaction and an approximate time of arrival of the ionization electrons, wherein the shutter system selectively blocks and permits the passage of the ionization electrons to the collector.

12. The method according to claim 11, wherein the portion of the shutter system is opened based on an expected time of arrival of the ionization electrons at the collector.

13. The method of claim 1, further comprising:

collecting data from the plurality of photodetectors and a collector; and

processing the data off-line to determine the second multi-dimensional position of the interaction.

14. An apparatus for determining a position of gamma ray interaction, comprising:

a region containing a medium, adapted to emit ionization electrons in response to an interaction between a gamma ray and the medium;

a plurality of photodetectors, adapted to determine a first multi-dimensional position of the interaction;

a collector, adapted to determine a second multi-dimensional position of the interaction by localizing the position of the interaction in two dimensions in the collector based on a position of the ionization electrons collected in the collector; and

a plurality of field wires, adapted to produce a drift field in the medium that directs ionization electrons to the collector.

15. The apparatus of claim 14, wherein the medium is further adapted to emit light, wherein the plurality of photodetectors are adapted to detect emitted light, and wherein the collector is adapted to detect a third multi-dimensional position of the interaction based on a time of arrival of the ionization electrons relative to when the emitted light is detected.

16. The apparatus according to claim 14, wherein the medium is a liquid.

17. The apparatus according to claim 14, wherein the medium is at least one of liquid xenon (Xe), liquid krypton (Kr) and liquid argon (Ar).

18. The gamma ray detector according to claim 14, wherein the medium is a noble gas.

19. The apparatus according to claim 14, wherein the drift field is established to provide a constant velocity in the medium.

20. The apparatus according to claim 19, wherein the medium is liquid xenon and the drift field set to 1 kV/cm causing the ionization electrons to drift at a speed of 0.2 cm/μs.

21. The apparatus according to claim 14, wherein the photodetectors include at least one of photo-multiplier tubes, position sensitive photo multipliers, photodiodes, avalanche photodiodes, hybrid photodiodes, visible light photodetectors, and any position sensitive photo-detectors.

22. The apparatus according to claim 15, further comprising:

a shutter system that selectively blocks and permits the passage of ionization electrons to the collector, wherein a portion of the shutter system corresponding to an approximate position of the interaction in two dimensions and an approximate time of arrival of the ionization corresponding to the third dimension is opened to allow the ionization electrons to pass to the collector; and

a triggering system that determines the portion of the shutter system that is opened and a time period that the shutter is opened based on light signals detected by the plurality of the photodetectors.

23. The apparatus according to claim 14, wherein the collector comprises a two-dimensional collection electrode array that localizes the position of the interaction in the two dimensions.

24. The apparatus according to claim 15, further comprising:

a processor that collects data from the plurality of photodetectors and the collector and processes the data off-line to determine the second multi-dimensional position of the interaction.

25. The method according to claim 1, wherein a distribution of light emitted from the medium and detected by the plurality of photodetectors is used to determine the first multi-dimensional position.

26. The method according to claim 1, wherein a difference of times at which light emitted from the medium arrives at the plurality of photodetectors is used to determine the first multi-dimensional position.

27. The method according to claim 1, wherein a distribution of light emitted from the medium and detected by the plurality of photodetectors and a difference of times at which the light arrives at the plurality of photodetectors are used to determine the first multi-dimensional position.

28. The apparatus according to claim 14, wherein a distribution of light emitted from the medium and detected by the plurality of photodetectors is used to determine the first multi-dimensional position.

29. The aparatus according to claim 14, wherein a difference of times at which light emitted from the medium arrives at the plurality of photodetectors is used to determine the first three-dimensional position.

30. The apparatus according to claim 14, wherein a distribution of light emitted from the medium and detected by the plurality of photodetectors and a difference of times at which the light arrives at the plurality of photodetectors are used to determine the first multi-dimensional position.

31. An apparatus for determining a position of a gamma ray interaction, the apparatus comprising:

means for emitting light in a medium in response to an interaction between a gamma ray and the medium;

means for determining a first multi-dimensional position of the interaction from a detected distribution of light emitted from the medium; and

means for producing a drift field in the medium to direct ionization electrons resulting from the interaction from which a second multi-

dimensional position of the interaction is determinable based on a position of the ionization electrons.

32. The apparatus of claim 31, further comprising:

means for collecting electrons resulting from the interaction, wherein the drift field directs ionization electrons resulting from the interaction to the means for collecting and wherein the second multi-dimensional position of the interaction is determined by localizing the position of the interaction in two dimensions in the means for collecting.

33. The apparatus of claim 31, further comprising:

means for determining a third multi-dimensional position based on a time of arrival of the ionization electrons relative to when light has been emitted from the medium.

34. The apparatus of claim 32, further comprising:

means for determining a third multi-dimensional position based on a time of arrival of the ionization electrons relative to when light has been emitted from the medium.

35. An apparatus for determining a position of a gamma ray interaction, the apparatus comprising:

means for emitting light in a medium in response to an interaction between a gamma ray and the medium;

means for determining a first multi-dimensional position of the interaction from a difference of times at which light emitted from the medium arrives at a plurality of photodetectors; and

means for producing a drift field in the medium to direct ionization electrons resulting from the interaction from which a second multi-dimensional position of the interaction is determinable based on a position of the ionization electrons.

36. The apparatus of claim 35, further comprising:

means for collecting electrons resulting from the interaction, wherein the drift field directs ionization electrons resulting from the interaction to the means for collecting and wherein the second multi-dimensional position of the interaction is determined by localizing the position of the interaction in two dimensions in the means for collecting.

37. The apparatus of claim 35, further comprising:

means for determining a third multi-dimensional position based on a time of arrival of the ionization electrons relative to when light has been emitted from the medium.

38. The apparatus of claim 36, further comprising:

means for determining a third multi-dimensional position based on a time of arrival of the ionization electrons relative to when light has been emitted from the medium.

39. An apparatus for determining a position of a gamma ray interaction, the apparatus comprising:

means for emitting light in a medium in response to an interaction between a gamma ray and the medium;

means for determining a first multi-dimensional position of the interaction from a difference of times at which light emitted from the medium arrives at a plurality of photodetectors and from a distribution of light emitted from the medium and detected by the plurality of photodetectors; and

means for producing a drift field in the medium to direct ionization electrons resulting from the interaction from which a second multi-dimensional position of the interaction is determinable based on a position of the ionization electrons.

40. The apparatus of claim 39, further comprising:

means for collecting electrons resulting from the interaction, wherein the drift field directs ionization electrons resulting from the interaction to the means for collecting and wherein the second multi-dimensional position

of the interaction is determined by localizing the position of the interaction in two dimensions in the means for collecting.

41. The apparatus of claim 39, further comprising:

means for determining a third multi-dimensional position based on a time of arrival of the ionization electrons relative to when light has been emitted from the medium.

42. The apparatus of claim 39, further comprising:

means for determining a third multi-dimensional position based on a time of arrival of the ionization electrons relative to when light has been emitted from the medium.

The method according to claim 39,

43. A method for determining a position of a gamma ray interaction, the method comprising:

determining a first multi-dimensional position of the interaction from a distribution of light emitted from the medium, in response to an interaction between a gamma ray and the medium, and detected by a plurality of photodetectors; and

determining a second multi-dimensional position of the interaction from a position of ionization electrons resulting from the interaction, directed from a drift field produced in the medium.

44. A method for determining a position of a gamma ray interaction, the method comprising:

determining a first multi-dimensional position of the interaction from a difference of times at which light emitted from the medium, in response to an interaction between a gamma ray and the medium, arrives at a plurality of photodetectors; and

determining a second multi-dimensional position of the interaction from a position of ionization electrons resulting from the interaction, directed from a drift field produced in the medium.

45. A method for determining a position of a gamma ray interaction, the method comprising:

determining a first multi-dimensional position of the interaction from a distribution of light emitted from the medium in response to an interaction between a gamma ray and the medium and detected by a plurality of photodetectors, and from a difference of times at which the light arrives at the plurality of photodetectors; and

determining a second multi-dimensional position of the interaction from a position of ionization electrons resulting from the interaction, directed from a drift field produced in the medium.